CLAIMS

What is claimed is:

1. An optical recording/reproducing apparatus comprising:

an optical pickup including

an optical splitting device which splits light emitted from a first light source into a main light beam and sub-light beams which are symmetrical with respect to the main light beam, and irradiates the split main and sub-light beams on a recording medium, and

a light detection device which receives the main light beam and the sub-light beams reflected by the recording medium, and outputs detection signals corresponding to the received main and sub-light beams, so as to detect tracking error signals in a three-beam method and one of a push-pull method and an improved push-pull method; and

a signal processor which receives the detection signals output by the light detection device and detects the tracking error signals in the three-beam method and the one of the push-pull method and the improved push-pull method, and otherwise detects selectively the tracking error signal in the three-beam method and the one of the push-pull method and the improved push-pull method, so as to realize an optimal tracking servo-control.

2. The apparatus as claimed in claim 1, wherein the optimal tracking servo-control is realized by using the tracking error signal in the three-beam method in response to the recording medium being a reproduction-only recording medium, and using the tracking error signal in one of the push-pull method and the improved push-pull method in response to the recording medium being a recording medium that can be recorded on at least once, according to a recording medium type signal detected by the optical recording/reproducing apparatus.

3. The apparatus as claimed in claim 2, wherein

the sub-light beams which are symmetrical with respect to the main light beam comprise first two sub-light beams and second two sub-light beams, and

the signal processor comprises:

a first detection portion which detects the tracking error signal in the three-beam method from first detection signals with respect to the first two sub-light beams,

wherein the first two sub-light beams are closer to the main light beam than the second two sub-light beams; and

a second detection portion which detects the tracking error signal in the improved push-pull method from second detection signals with respect to the second two sub-light beams and main detection signals with respect to the main light beam.

4. The apparatus as claimed in claim 3, wherein the signal processor further comprises:

a switch which is installed one of between the light detection device, and the first and second detection portions, and at output terminals of the first and second detection portions; and

a controller which controls the switch by using the recording medium type signal so as to detect the tracking error signal with one of the first and second detection portions.

5. The apparatus as claimed in claim 1, wherein

the sub-light beams which are symmetrical with respect to the main light beam comprise first two sub-light beams and second two sub-light beams, and

the signal processor comprises:

a first detection portion which detects the tracking error signal in the three-beam method from first detection signals with respect to the first two sub-light beams, wherein the first two sub-light beams are closer to the main light beam than the second two sub-light beams; and

a second detection portion which detects the tracking error signal in the improved push-pull method from second detection signals with respect to the second two sub-light beams and main detection signals with respect to the main light beam.

6. The apparatus as claimed in claim 5, wherein the signal processor further comprises:

a switch which is installed one of between the light detection device, and the first and second detection portions, and at output terminals of the first and second detection portions; and

a controller which controls the switch so as to have one of the first and second detection portions detect the tracking error signal.

7. The apparatus as claimed in claim 4, wherein the controller detects the tracking error signal in the three-beam method in response to the recording medium being the reproduction-only recording medium, and detects the tracking error signal in the improved push-pull method in response to the recording medium being the recording medium which can be recorded on at least once, according to the recording medium type signal detected by the optical recording/reproducing apparatus.

8. The apparatus as claimed in claim 6, wherein the controller detects the tracking error signal in the three-beam method in response to the recording medium being a reproduction-only recording medium and the tracking error signal in the improved push-pull method in response to the recording medium being a recording medium which can be recorded on at least once, according to a recording medium type signal detected by the optical recording/reproducing apparatus.

9. The apparatus as claimed in claim 1, wherein

the sub-light beams comprise first two sub-light beams and second two sub-light beams, and

the light detection device comprises:

a main photodetector which detects the main light beam;

first sub-photodetectors which receive corresponding ones of the first two sub-light beams, wherein the first two sub-light beams are closer to the main light beam than the second two sub-light beams; and

second sub-photodetectors which receive corresponding ones of the second two sub-light beams.

10. The apparatus as claimed in claim 2, wherein

the sub-light beams comprise first two sub-light beams and second two sub-light beams, and

the light detection device comprises:

a main photodetector which detects the main light beam;

first sub-photodetectors which receive corresponding ones of the first two sub-light beams, wherein the first two sub-light beams are closer to the main light beam than the second two sub-light beams; and

second sub-photodetectors which receive corresponding ones of the second two sub-light beams.

11. The apparatus as claimed in claim 3, wherein the light detection device comprises:

a main photodetector which detects the main light beam;

first sub-photodetectors which receive corresponding ones of the first two sub-light beams; and

second sub-photodetectors which receive corresponding ones of the second two sub-light beams.

12. The apparatus as claimed in claim 5, wherein the light detection device comprises:

a main photodetector which detects the main light beam;

first sub-photodetectors which receive corresponding ones of the first two sub-light beams; and

second sub-photodetectors which receive corresponding ones of the second two sub-light beams.

13. The apparatus as claimed in claim 9, wherein

the main photodetector comprises of a plurality of sections, and

each of the second sub-photodetectors comprises of one of two sections and four sections.

14. The apparatus as claimed in claim 9, further comprising a light detection device circuit including:

a current-to-voltage converting unit which converts each of current signals output from the main photodetector and the first and second sub-photodetectors into a corresponding one of voltage signals, and outputs each of the converted voltage signals as a corresponding one of the detection signals; and

a switch which selectively outputs each of the detection signals from a corresponding one of the first and second sub-photodetectors.

15. The apparatus as claimed in claim 14, wherein the signal processor detects the tracking error signal selectively in one of the improved push-pull method and the three-beam method, and outputs the detected tracking error signal, by controlling the switch according to a recording medium type signal of the optical recording/reproducing apparatus.

16. The apparatus as claimed in claim 1, further comprising a light detection device circuit including a current-to-voltage converting unit which converts each of current signals output from the light detection device into a corresponding one of voltage signals and outputs each of the converted voltage signals as a corresponding one of the detection signals.

17. The apparatus as claimed in claim 2, further comprising a light detection device circuit including a current-to-voltage converting unit which converts each of current signals output from the light detection device into a corresponding one of voltage signals and outputs each of the converted voltage signals as a corresponding one of the detection signals.

18. The apparatus as claimed in claim 3, further comprising a light detection device circuit including a current-to-voltage converting unit which converts each of current signals output from the light detection device into a corresponding one of voltage signals and outputs each of the converted voltage signals as a corresponding one of the main, first and second detection signals.

19. The apparatus as claimed in claim 4, further comprising a light detection device circuit including a current-to-voltage converting unit which converts each of current signals output from the light detection device into a corresponding one of voltage signals and outputs each of the converted voltage signals as a corresponding one of the main, first and second detection signals.

20. The apparatus as claimed in claim 5, further comprising a light detection device circuit including a current-to-voltage converting unit which converts each of current signals output from the light detection device into a corresponding one of voltage signals and outputs each of the converted voltage signals as a corresponding one of the main, first and second detection signals.

21. The apparatus as claimed in claim 6, further comprising a light detection device circuit including a current-to-voltage converting unit which converts each of current signals output from the light detection device into a corresponding one of voltage signals and outputs each of the converted voltage signals as a corresponding one of the main, first and second detection signals.

22. The apparatus as claimed in claim 1, wherein the optical splitting device comprises a diffracting device which diffracts the light emitted from the first light source into 0^{th} order, $\pm 1^{st}$ order, and $\pm 2^{nd}$ order diffracted light beams.

23. The apparatus as claimed in claim 2, wherein the optical splitting device comprises a diffracting device which diffracts the light emitted from the first light source into 0^{th} order, $\pm 1^{st}$ order, and $\pm 2^{nd}$ order diffracted light beams.

24. The apparatus as claimed in claim 3, wherein the optical splitting device comprises a diffracting device which diffracts the light emitted from the first light source into 0^{th} order, $\pm 1^{st}$ order, and $\pm 2^{nd}$ order diffracted light beams.

25. The apparatus as claimed in claim 4, wherein the optical splitting device comprises a diffracting device which diffracts the light emitted from the first light source into 0^{th} order, $\pm 1^{st}$ order, and $\pm 2^{nd}$ order diffracted light beams.

26. The apparatus as claimed in claim 5, wherein the optical splitting device comprises a diffracting device which diffracts the light emitted from the first light source into 0^{th} order, $\pm 1^{st}$ order, and $\pm 2^{nd}$ order diffracted light beams.

27. The apparatus as claimed in claim 6, wherein the optical splitting device comprises a diffracting device which diffracts the light emitted from the first light source into 0^{th} order, $\pm 1^{st}$ order, and $\pm 2^{nd}$ order diffracted light beams.

28. The apparatus as claimed in claim 22, wherein the diffracting device performs diffraction so as to have a diffraction ratio between the 0^{th} order, the $\pm 1^{st}$ order, and the $\pm 2^{nd}$ order diffracted light beams that is substantially 8-16:0.3-2.3:0.3-2.3, and a total diffraction efficiency of the 0^{th} order, the $\pm 1^{st}$ order, and the $\pm 2^{nd}$ order diffracted light beams with respect to an incident light beam that is at least 70%.

29. The apparatus as claimed in claim 1, wherein the sub-light beams comprises first two sub-light beams which are closest to the main light beam and have a phase difference of about 180° with respect to each other.

30. The apparatus as claimed in claim 2, wherein the sub-light beams comprises first two sub-light beams which are closest to the main light beam and have a phase difference of about 180° with respect to each other.

31. The apparatus as claimed in claim 3, wherein the first two sub-light beams and have a phase difference of about 180° with respect to each other.

32. The apparatus as claimed in claim 4, wherein the first two sub-light beams and have a phase difference of about 180° with respect to each other.

33. The apparatus as claimed in claim 5, wherein the first two sub-light beams and have a phase difference of about 180° with respect to each other.

34. The apparatus as claimed in claim 6, wherein the first two sub-light beams and have a phase difference of about 180° with respect to each other.

35. The apparatus as claimed in claim 2, wherein

the sub-light beams which are symmetrical with respect to the main light beam comprise two sub-light beams, and

the signal processor comprises:

a first detection portion which detects the tracking error signal in the push-pull method by using main detection signals with respect to the main light beam; and

a second detection portion which detects the tracking error signal in the three-beam method by using second detection signals with respect to the two sub-light beams which are symmetrical with respect to the main light beam.

36. The apparatus as claimed in claim 35, wherein the signal processor further comprises:

a switch which is installed at output terminals of the first and second detection portions; and

a controller which controls the switch by using the recording medium type signal so as to output the tracking error signal selectively from one of the first and second detection portions.

37. The apparatus as claimed in claim 1, wherein

the sub-light beams which are symmetrical with respect to the main light beam comprise two sub-light beams, and

the signal processor comprises:

a first detection portion which detects the tracking error signal in the push-pull method by using main detection signals with respect to the main light beam; and

a second detection portion which detects the tracking error signal in the three-beam method by using second detection signals with respect to the two sub-light beams which are symmetrical with respect to the main light beam.

38. The apparatus as claimed in claim 37, wherein the signal processor further comprises:

a switch which is installed at output terminals of the first and second detection portions; and

a controller which controls the switch by using a recording medium type signal detected by the optical recording/reproducing apparatus so as to output the tracking error signal selectively from one of the first and second detection portions.

39. The apparatus as claimed in claim 35, wherein the light detection device comprises:

a main photodetector which detects the main light beam; and

sub-photodetectors which receive corresponding ones of the two sub-light beams.

40. The apparatus as claimed in claim 36, wherein the light detection device comprises:

a main photodetector which detects the main light beam; and

sub-photodetectors which receive corresponding ones of the two sub-light beams.

41. The apparatus as claimed in claim 37, wherein the light detection device comprises:

a main photodetector which detects the main light beam; and

sub-photodetectors which receive corresponding ones of the two sub-light beams.

42. The apparatus as claimed in claim 38, wherein the light detection device comprises:

a main photodetector which detects the main light beam; and

sub-photodetectors which receive corresponding ones of the two sub-light beams.

43. The apparatus as claimed in claim 39, wherein the main photodetector comprises a structure having a plurality of sections.

44. The apparatus as claimed in claim 1, wherein the optical splitting device comprises a diffracting device which diffracts the light emitted from the first light source into 0^{th} order and $\pm 1^{st}$ order diffracted light beams.

45. The apparatus as claimed in claim 2, wherein the optical splitting device comprises a diffracting device which diffracts the light emitted from the first light source into 0^{th} order and $\pm 1^{st}$ order diffracted light beams.

46. The apparatus as claimed in claim 35, wherein the optical splitting device comprises a diffracting device which diffracts the light emitted from the first light source into 0^{th} order and $\pm 1^{st}$ order diffracted light beams.

47. The apparatus as claimed in claim 36, wherein the optical splitting device comprises a diffracting device which diffracts the light emitted from the first light source into 0^{th} order and $\pm 1^{st}$ order diffracted light beams.

48. The apparatus as claimed in claim 37, wherein the optical splitting device comprises a diffracting device which diffracts the light emitted from the first light source into 0^{th} order and $\pm 1^{st}$ order diffracted light beams.

49. The apparatus as claimed in claim 38, wherein the optical splitting device comprises a diffracting device which diffracts the light emitted from the first light source into 0^{th} order and $\pm 1^{st}$ order diffracted light beams.

50. The apparatus as claimed in claim 1, wherein the optical pickup further comprises:

a first optical path changing device which changes a proceeding path of an incident light; and

an objective lens which condenses the main light beam and the sub-light beams split by the optical splitting device, and focuses the condensed main and sub-light beams on the recording medium.

51. The apparatus as claimed in claim 2, wherein the optical pickup further comprises:

a first optical path changing device which changes a proceeding path of an incident light; and

an objective lens which condenses the main light beam and the sub-light beams split by the optical splitting device, and focuses the condensed main and sub-light beams on the recording medium.

52. The apparatus as claimed in claim 3, wherein the optical pickup further comprises:

a first optical path changing device which changes a proceeding path of an incident light; and

an objective lens which condenses the main and sub-light beams split by the optical splitting device, and focuses the condensed main and sub-light beams on the recording medium.

53. The apparatus as claimed in claim 4, wherein the optical pickup further comprises:

a first optical path changing device which changes a proceeding path of an incident light; and

an objective lens which condenses the main and sub-light beams split by the optical splitting device, and focuses the condensed main and sub-light beams on the recording medium.

54. The apparatus as claimed in claim 5, wherein the optical pickup further comprises:

a first optical path changing device which changes a proceeding path of an incident light; and

an objective lens which condenses the main and sub-light beams split by the optical splitting device, and focuses the condensed main and sub-light beams on the recording medium.

55. The apparatus as claimed in claim 6, wherein the optical pickup further comprises:

a first optical path changing device which changes a proceeding path of an incident light; and

an objective lens which condenses the main and sub-light beams split by the optical splitting device, and focuses the condensed main and sub-light beams on the recording medium.

56. The apparatus as claimed in claim 35, wherein the optical pickup further comprises:

a first optical path changing device which changes a proceeding path of an incident light; and

an objective lens which condenses the main and sub-light beams split by the optical splitting device, and focuses the condensed main and sub-light beams on the recording medium.

57. The apparatus as claimed in claim 36, wherein the optical pickup further comprises:

a first optical path changing device which changes a proceeding path of an incident light; and

an objective lens which condenses the main and sub-light beams split by the optical splitting device, and focuses the condensed main and sub-light beams on the recording medium.

58. The apparatus as claimed in claim 37, wherein the optical pickup further comprises:

a first optical path changing device which changes a proceeding path of an incident light; and

an objective lens which condenses the main and sub-light beams split by the optical splitting device, and focuses the condensed main and sub-light beams on the recording medium.

59. The apparatus as claimed in claim 38, wherein the optical pickup further comprises:

a first optical path changing device which changes a proceeding path of an incident light; and

an objective lens which condenses the main and sub-light beams split by the optical splitting device, and focuses the condensed main and sub-light beams on the recording medium.

60. The apparatus as claimed in claim 50, wherein the optical pickup further comprises an adjustment lens which adjusts astigmatism of light reflected by the recording medium.

61. The apparatus as claimed in claim 60, wherein the sub-light beams comprises first two sub-light beams and second two sub-light beams, and

the light detection device comprises:

a main photodetector which detects the main light beam;

first photodetectors which receive corresponding ones of the first two sub-light beams, wherein the first two sub-light beams are closer to the main light beams than the second two sub-light beams; and

second photodetectors which receive corresponding ones of the second two sub-light beams, wherein each of the second sub-photodetectors of the optical pickup comprises of four sections so as to detect a focus error signal in an improved astigmatism method, wherein the improved astigmatism (d-FES) is determined according to:

$$d\text{-}FES=((A+C)-(B+D))-k'(\{(E1+F1)+(E3+F3)\}-\{(E2+F2)+(E4+F4)\})$$

where A, B, C and D are main detection signals from the main photodetector, E1, E2, E3, E4, F1, F2, F3 and F4 are second detection signals from the second photodetectors, and k' is a gain applied to the second detection signals.

62. The apparatus as claimed in claim 50, wherein the optical pickup further comprises:

a second light source which emits light having a wavelength different from that of the light from the first light source; and

a second optical path changing device which irradiates the light emitted from the second light source toward the recording medium, so as to compatibly adopt to recording media having different formats .

63. The apparatus as claimed in claim 62, further comprising a first collimating lens which collimates the light emitted from the first and second light sources.

64. The apparatus as claimed in claim 63, further comprising a second collimating lens which is situated between the first light source and the first collimating lens.

65. The apparatus as claimed in claim 62, wherein one of the first and second light sources emits light having a wavelength appropriate for recording/reproducing information with respect to a CD-family recording medium and the other light source emits light having a wavelength appropriate for recording/reproducing information with respect to a DVD-family recording medium.

66. The apparatus as claimed in claim 1, wherein the optical pickup further comprises a second light source which emits light having a wavelength different from that of the light emitted from the first light source, wherein the light emitted from the second light source land on the recording medium, so as to compatibly adopt to recording media having different formats.

67. The apparatus as claimed in claim 2, wherein the optical pickup further comprises a second light source which emits light having a wavelength different from that of the light emitted from the first light source, wherein the light emitted from the second light source land on the recording medium, so as to compatibly adopt to recording media having different formats.

68. A method of detecting a tracking error signal in an optical recording/reproducing apparatus, the method comprising:

splitting light emitted from a light source into a main light beam and sub-light beams which are symmetrical with respect to the main light beam;

irradiating the split light beams on a recording medium;

detecting the main light beam and the sub-light beams reflected by the recording medium; and

detecting the tracking error signal by using detection signals of the main light beam and/or the sub-light beams in a three-beam method and one of a push-pull method and an improved push-pull method, and otherwise in one of the three-beam method, the push-pull method, and the improved push-pull method.

69. The method as claimed in claim 68, wherein the detecting of the tracking error signal comprises:

selecting a tracking servo-control method including one or a combination of the three-beam method, the push-pull method and the improved push-pull method according to a recording medium type signal detected by the optical recording/reproducing apparatus; and

detecting the tracking error signal according to the selected tracking servo-control method.

70. The method as claimed in claim 68, wherein, the detecting of the tracking error signal comprises:

using a recording medium type signal detected by the optical recording/reproducing apparatus; and

detecting the tracking error signal in the three-beam method in response to the recording medium being a reproduction-only recording medium, and detecting the tracking error signal in one of the push-pull method and the improved push-pull method in response to the recording medium being a recording medium which can be recorded on at least once.

71. The method as claimed in claim 69, wherein, the detecting of the tracking error signal comprises:

using the recording medium type signal detected by the optical recording/reproducing apparatus; and

detecting the tracking error signal in the three-beam method in response to the recording medium being a reproduction-only recording medium, and detecting the tracking error signal in one of the push-pull method and the improved push-pull method in response to the recording medium being a recording medium which can be recorded on at least once.

72. An optical recording/reproducing apparatus comprising:

an optical pickup including

an optical splitting device which splits light emitted from a first light source into a main light beam and sub-light beams which are symmetrical with respect to the main light beam, and irradiates the split main and sub-light beams, and

a light detection device which receives the main and sub-light beams reflected from a recording medium, and outputs detection signals corresponding to the received main and sub-light beams; and

a signal processor which receives the detection signals and detects tracking error signals in a three-beam method and one of a push-pull method and an improved push-pull method, and otherwise detects the tracking error signal by selectively using the detection signals corresponding to one of the three-beam method, the push-pull method and the improved push-pull method according to a recording medium type signal, so as to realize an optimal tracking servo-control.

73. The apparatus as claimed in claim 72, wherein the signal processor detects the tracking error signal in the three-beam method in response to the recording medium which comprises a reproduction-only recording medium, and in one of the push-pull method and the improved push-pull method in response to the recording medium which comprises a recordable recording medium, according to the recording medium type signal detected by the optical recording/reproducing apparatus.

74. The apparatus as claimed in claim 73, wherein the optical pickup further comprises a second light source which emits a second light having a wavelength different from that of the light from the first light source, wherein the second light is irradiated on the recording medium so as allow the optical recording/reproducing apparatus to compatibly adopt to recording media having different formats.

75. An optical recording/reproducing apparatus comprising:

an optical pickup including

an optical splitting device which splits light emitted from a first light source into a main light beam and sub-light beams which are symmetrical with respect to the main light beam, and irradiates the split main and sub-light beams, and

a light detection device which receives the main and sub-light beams reflected from a recording medium, and outputs detection signals corresponding to the received main and sub-light beams; and

a signal processor which receives the detection signals and detects a tracking error signal in accordance with a plurality of tracking servo control methods according to a type of the recording medium and independent of depths of pits formed in the recording medium.

76. An optical recording/reproducing apparatus comprising:

an optical pickup including

an optical splitting device which splits light emitted from a first light source into a main light beam and sub-light beams which are symmetrical with respect to the main light beam, and irradiates the split main and sub-light beams, and

a light detection device which receives the main and sub-light beams reflected from a recording medium, and outputs detection signals corresponding to the received main and sub-light beams; and

a signal processor which receives the detection signals and detects tracking error signals in a three-beam method and a push-pull method according to a recording medium type signal detected by the optical recording/reproducing apparatus.